ON THE BUSES

David Daamen

Being able to control a TV or a stereo from the comfy chair is taken for granted these days. However, home automation does not stop at remote control for audio & video equipment. Although an increasing number of manufacturers jump the bandwagon called Home Automation or even the Smart Home, there are no signs as yet of a real breakthrough 'for the millions'.

Although several systems are currently available on the market to automate various functions in and around the home, the large number of different, competing, standards and proprietary developments is a large stumbling bock on the road towards the Home of the Future.

In an earlier issue we wrote that developments in home automation were being slowed down by the possibilities and impossibilities of facility engineering ('Home Bus Systems', *Elektor Electronics* February 2001). Apparently, developing and marketing a compatible system is time

Last station still far off

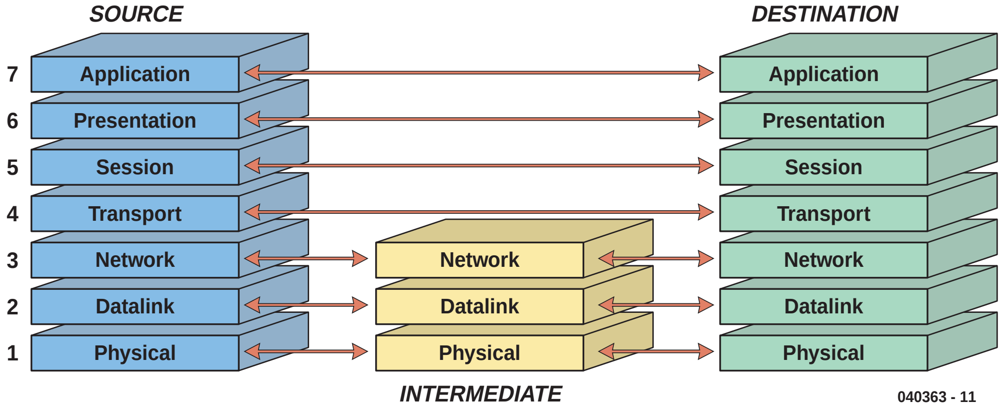

Figure 1. The Open Systems Interconnect (OSI) model developed by the ISO.

consuming to the extent that manufacturers are always one step behind reality.

One of the main problems seems to be flaky exchange of data between different applications. Once the main hitches have been recognised, it is often impossible to make amends at the high pace that rules in the electronics industry. This situation has resulted in a plethora of different protocols and standards which only seems to aggravate the problem.

Lessons have been learned, however, because today the trend is not just to look at the connection method, but increasingly at the actual application.

OSI

The fact that it has taken so long for the system designers to spend time on the application is not surprising in itself. Since the mid-1980s, there exists a standard describing the aspects to take into account when implementing the network functionality. At that time, the ISO (International Standards Organization) published a reference model called *Open Systems Interconnect* (OSI), see **Figure 1**.

A bit further on, we'll see that besides many standards concentrating on the actual connection and/or the manner of communicating, there are now also standards giving due attention to the highest layers of the OSI model: the area where the actual application is concerned.

For convenience's sake, we will divide the standards (professional networking and home automation) into three categories derived from the OSI reference model. The subdivision is into (1) the network layer; (2) the communication layer and (3) the application layer.

Networking

Standards like *RS-485*, *Ethernet*, *FireWire*, *HomePNA*, *HomePlug*, *MoCA*, *USB* and *X10* are primarily descriptions of ways to communicate over a physical medium. *HomePNA*, for instance, is a standard with widespread use in the USA, describing how connections with speeds up to 240 Mbit/s can be established within the home using the (existing) telephone wiring. The *Multimedia over Coax Alliance* has published a standard based on the same principle: making use of existing cabling — in this case, coax cabling already installed in many homes for the distribution of (analogue) radio and TV signals. According to the MoCA, the standard is future-proof and capable of speeds up to 1 Gbit/s.

The *HomePlug* standard now 'on the rise' in Europe also employs existing cabling — the mains wiring installed in your home. Speeds up to 14 Mbit/s are said to be within reach.

Arguably, wireless standards like *Bluetooth*, *ZigBee*, *DECT*, *WiFi* and *IrDA* also belong to the network category. The '**Bus Systems**' **inset** provides links to more information on all these standards.

In the network layer, the focus is on physical interoperability (connectivity), hence most standards do not go beyond the first layers of the OSI model.

The upshot is that such standards are not terribly useful without agreements on how data is being transmitted and this is where the need for a networking protocol becomes apparent. Today, IP (Internet protocol) is the most frequently used.

Communication

The comms layer comprises standards like *BACnet*, *BatiBUS*, *EIB*, *EIBA*, *LonWorks* and *KNX*. The latter will be reverted to below. These are primarily communications systems. The standards describe the data packets travelling up and down the network between machines (ter-

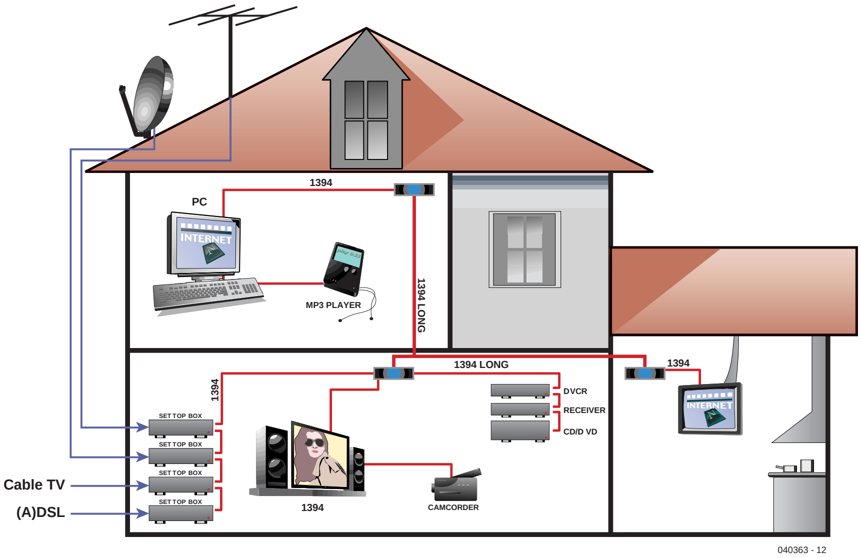

Figure 2. HAVi is based on a Firewire link for conveying digital audio and video signals.

minals), without a connection having been set up beforehand.

In this context, inter-operability is crucial. One of the ways to achieve it is to agree on a transmission scheme that's not dependent on the data being sent. This will fit in very well in an 'open' system, the protocols being universal and free for use by anyone. Incidentally, a system based on 'open' specifications is eventually closed of its own accord when it is used in a certain application or configuration!

Application

Within the standards normally associated with this layer, the emphasis is on system and application management. Consequently, the main aim of the standard is to define a so-called network-independent API (Application Program-

Bus systems

Network layer

RS-485	Recommended Standard ANSI/TIA/EIA-485-A-98	www.tiaonline.org
IEEE 802.3	Ethernet	standards.ieee.org
IEEE 1394	FireWire	www.apple.com
HomePNA	Home Phoneline Network Alliance	www.homepna.org
HomePlug	HomePlug Powerline Alliance	www.homeplug.org
MoCA	Multimedia over Coax Alliance	www.mocalliance.org
USB	Universal Serial Bus	www.usb.org
X10	X10 Wireless Technology	www.x10.com
IEEE 802.15	Bluetooth	www.bluetooth.com
ZigBee	ZigBee Alliance	www.zigbee.org
DECT	Digital Enhanced Cordless Telecommunications	www.dectweb.com
IEEE 802.11	Wireless Fidelity (WiFi) / Wireless LAN	www.wi-fi.org
IrDA	Infrared Data Association	www.irda.org

Communication layer

BACnet	Building Automation and Control Networks	www.bacnet.org
BatiBUS	BatiBUS Club International	www.batibus.com
EIB	European Installation Bus	www.eiba.com
KNX	Konnex Association	www.konnex.org
LonWorks	Local Operating Network Works	www.echelon.com

Application layer

CEBus	Consumer Electronics Bus	www.cebus.org
Modbus	Modicon bus	www.modbus.org
PROFIBUS	PROFIBUS International	www.profibus.com
HAVi	Home Audio Video Interoperability	www.havi.org
EHS	European Home System	www.smarthomeforum.com
OSGi/RG	Open Service Gateway initiative/Residential Gateways	www.osgi.org
Salutation	Salutation Architecture	www.salutation.org
UPnP	Universal Plug and Play	www.upnp.org

ming Interface). This category comprises standards like *CEBUs*, *ModBus*, *PROFIBUS*, *HAVi*, *EHS*, *OSGi* and *UPnP*.
Whereas *CEBus* is used predominantly in the US of A, initiatives like *HAVi* and *UPnP* refer to truly global developments. You may already have heard of *UPnP*, the concept of plug-and-play being familiar from the Windows/PC environment where it is fully integrated in the hardware and software concepts.
For clarity's sake we should mention that there is an amount of overlap in the categories mentioned. For example, certain standards from the network category are often complemented with solutions for management and control. The opposite also applies where a certain medium is sometimes chosen as the basis for an application group. This applies to, for example, *HAVi*, a system with its roots firmly in Firewire (IEEE1394) and intended as a connection standard for digital audio and video signals (**Figure 2**).

Figure 3. Logo of the Konnex Association.

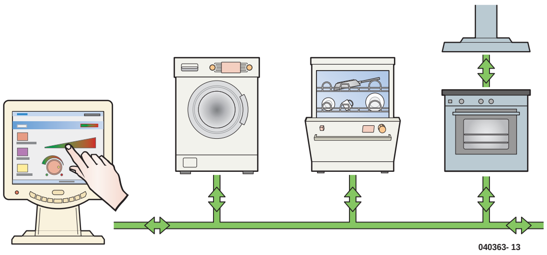

Figure 4. Eventually, all equipment in the home will be able to communicate with each other.

Konnex

A full discussion of every available standard is unfortunately beyond the scope of this article, hence we will pick out one we think is particularly interesting. The standard proposed by the *European Home System Association* (ESHA) is a good example of how it should be done. Apart from supplying specifications on medium and communication protocols, the consortium aims at furnishing a solution that's brand-independent, auto-configuring (plug and play), modular and future-proof. The fact that *ESHA*, *BatiBus* and *EIB* decide to team up to form the *Konnex Association* (**Figure 3**) is sure to help achieve the original goals.
Because the standard is open and platform-independent while also supporting various real-world media, we believe it will see increasing coverage in the future.

In practice

So what does the future hold in respect of home automation system? With a well-founded base approaching rapidly, the possibilities are in principle only limited by our fantasy — or that of the manufacturers, of course. Today's ability to control the TV or stereo rack from the comfy chair is just a harbinger of what we can expect to see in a few years time. Meanwhile we have to make do with remote control lighting systems now available from builders' markets. However, this will not be terribly interesting until other systems are integrated (**Figure 4**). Just think of a voice-controlled computer assisting you with measurement and control functions in and around the home, or the central heating activity linked to a time programmed on an alarm clock. A quarter of an hour before you get up, the domotics system provides a comfortable temperature in the bathroom! Taking this one step further, the coffee machine is switched on automatically when you leave the shower.
Home automation may also contribute significantly to security. For example, in your absence a central system may simulate activity in the home and even text you when an alarm condition arises from intruder, flood, high/low temperature or smoke detection, so you get an alert when you've left the oven on!

Do it yourself domotics

With consumers waiting for the industry to come up with proper and affordable systems, it is not surprising to see a flood of DIY solutions on the Internet. A couple of these will be discussed in a future instalment of E-Online. Meanwhile, why not have a look at what's brewing on the websites of 'Homeseer' and 'Home Automated Living', which supply examples of hardware and software that allows you to start integrating and automating your home right here and now. The relevant web links may be found below.

(040363-1)

Web links

www.hometoys.com
www.smarthomeforum.com

Software and hardware

www.homeseer.com
www.automatedliving.com

Previously on Elektor

Elektor Electronics has a long history of articles on bus systems suitable for DIY home automation. The most important contributions are listed below.

- RS485 meets CAN; two systems on one bus (Elektor Electronics October 2001)
- RS232 to RS485 Half-Duplex Adapter; advantages of balanced lines (Elektor Electronics May 2002)
- DCI Bus; RS485 home network with a maximum of 64 terminals (Elektor Electronics December 2002)
- USB-RS232 Interface; a compact solution for missing ports (Elektor Electronics April 2003)
- Controller Area Network (CAN bus); intelligent data communications in practice (Elektor Electronics September through December 1999)

Elsewhere in this issue you'll find references to a number of recent construction projects that fit in with this month's focus on Domotics. With a little inventiveness all of these can be bused!